

Geographic Information Systems

Definition

A combination of computer technologies that integrate:

- **graphic elements**
- **relational databases**
- **spatial relationships**

What GIS Can Do

- Analyze spatial and temporal relationships that exist among environmental factors
- Observe and compare data in a series of thematic layers
- Establish and maintain an inventory of resources
- Create a decision-making tool

Geographic Information Systems

Cartographic Methods

- Geometrical analysis of point, line, and polygon features
- Surface fitting and modeling
- Spatial trends
- Directional analysis and routing

Remote Sensing Methods

- Image interpretation and analysis
- Classification methods
- Morphological function and elevation modeling
- Transformational analyses

GIS in Veterinary Services

Purpose

To analyze animal health, regulatory, and trade issues by using spatial analysis methods to:

- Identify activities or programs in Veterinary Services that could benefit from geospatial analytical techniques.
- Develop specific tools for analyses that will yield new information not readily available by other methods.

GIS in Veterinary Services

Projects

- Internal
- External

Training

- Focused on specific needs of the customer
- Helping customers to plan for future needs

Consulting

- Assist in identifying appropriate projects
- Help in project design and implementation
- Provide information about hardware, software, and analytical methods

Strategies for Project Selection

- Will geospatial analysis provide information not readily available by other methods?
- Will this information satisfy a need within Veterinary Services?
- Is this a special opportunity to develop analytical tools that will benefit our agency?
- Is there enough interest and momentum to produce a high quality product in a timely manner?

Potential Benefits of GIS



Qualitative

- Enhanced tracking of complaints
- Continuous analysis of data
- Production of speciality maps
- Improved emergency preparedness

Potential Benefits of GIS



Quantitative

- Routine tasks are automated
- Improved access to data
- Centralization of data
- Rapid production of reports and maps

Geospatial Methods

- Digital Cartography
- Geodesy
- Remote Sensing
- Automated Mapping / Facilities Management
- Spatial Statistics
- Geographic Information Systems

GIS Object Types

Point



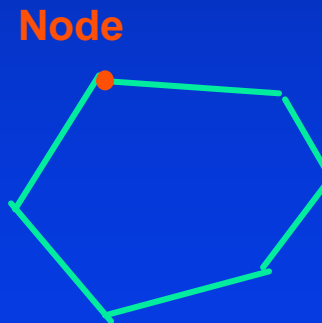
Line

Node

Node



Polygon



Topology

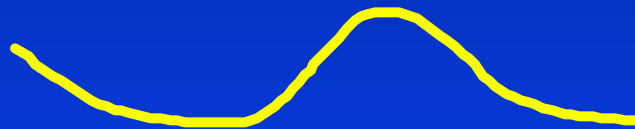
Definition

Topology - is the establishment of spatial relationships among points, lines, and polygons.

Information Types



Location



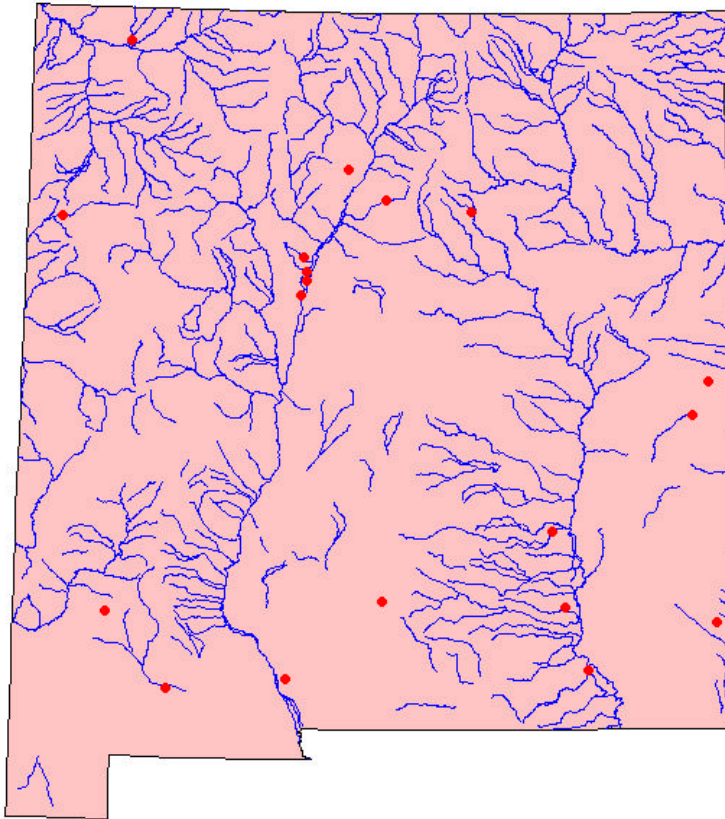
Length



Perimeter and Area

GIS Object Types

Data Examples



Point (Cities)



Line (Rivers)



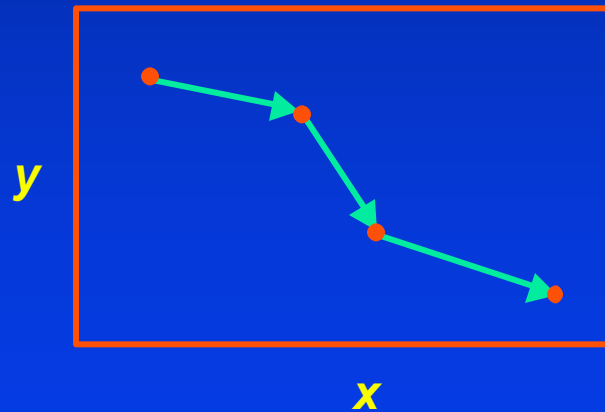
Polygon (States)

GIS Data Types

Raster



Vector



GIS Data

Information Quality

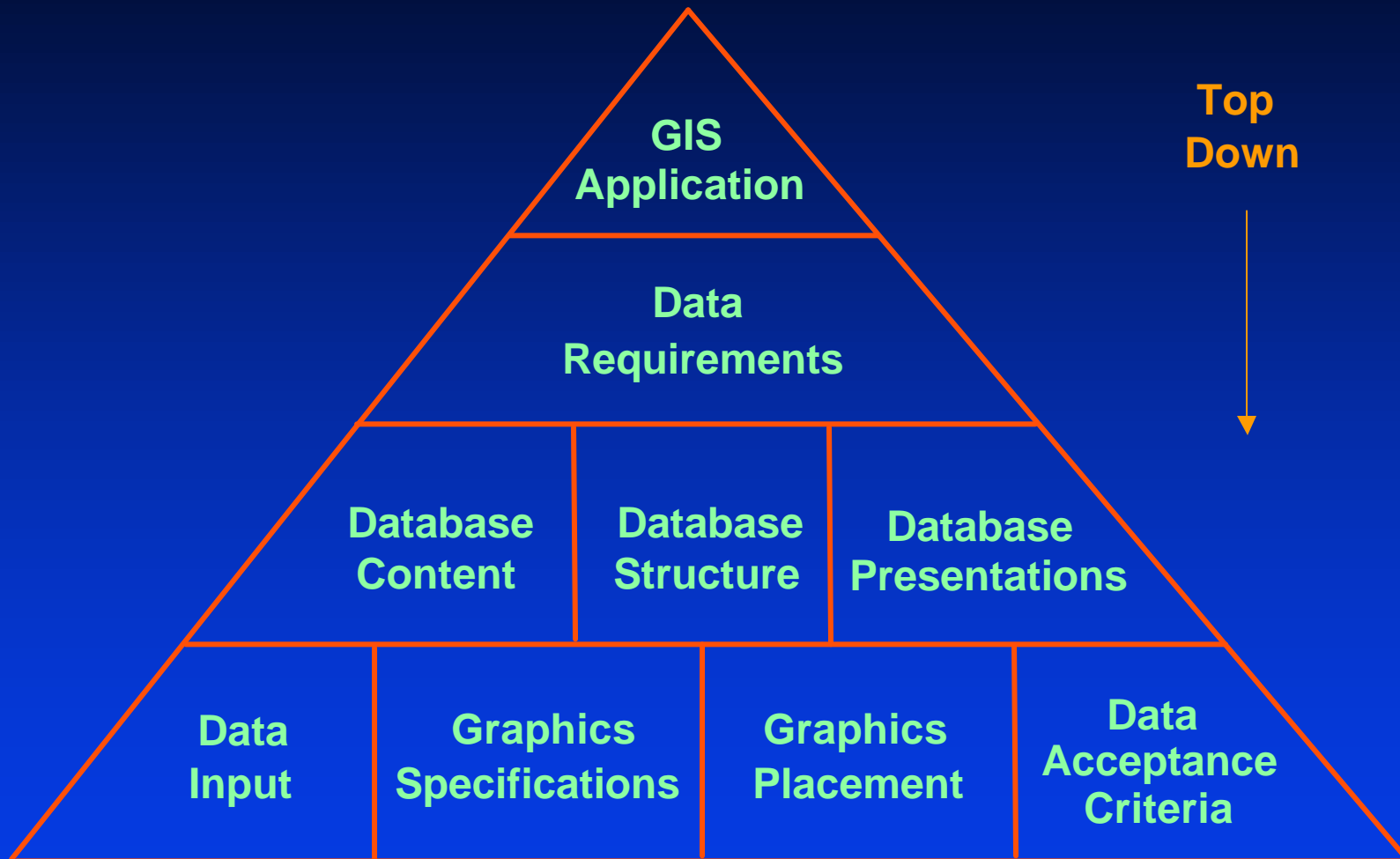
- Completeness
- Correctness
- Timeliness
- Integrity

GIS Data Quality

Cartographic Quality

- *Relative accuracy* - difference in the interval between two objects measured on a map and the same two objects measured in the field.
- *Absolute accuracy* - difference in the location of a feature on a map and its actual location on the surface of the earth.
- *Graphic quality* - refers to the legibility of the data.

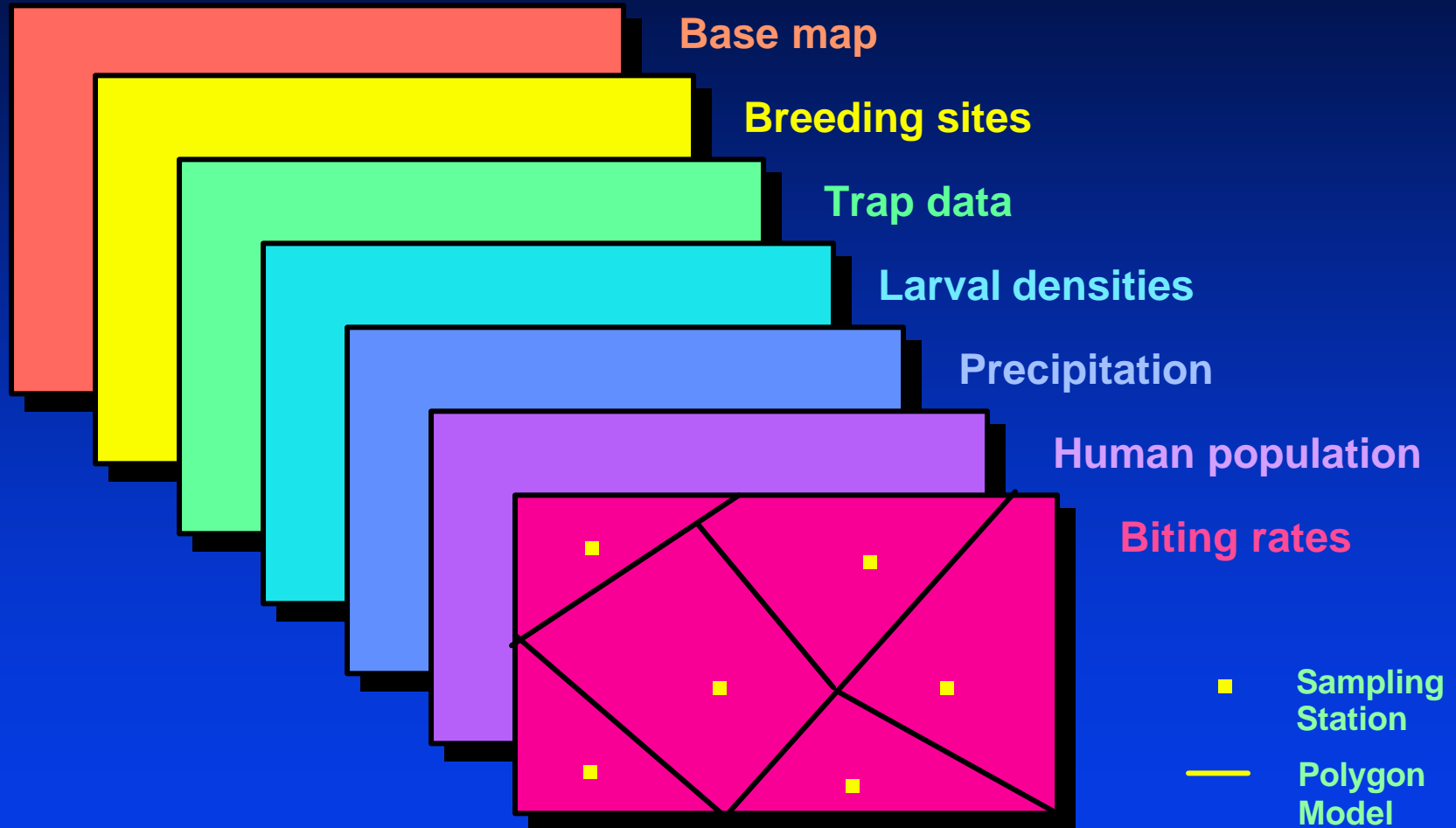
GIS Data Requirements



Confidentiality of Spatial Data

- **Security Methods**
 - Password Protection
 - Generalization
- **Specific Location**
 - Name and Address
 - » Private
 - » Commercial
 - » Licensed Operation
 - Premises ID (Coded)
- **Generalized Location**
 - Zip Code (Centroid or Polygon)
 - Census Districts
 - Township
 - Grid
 - Census District
 - County
 - Subregion
 - Region

Overlaying GIS Layers



Components of Pest Management in Agriculture

- Identify pests to be managed
- Geographically define the management unit
- Develop a pest-management strategy
- Select reliable monitoring techniques
- Establish economic thresholds
- Evolve descriptive and predictive models

Source: Metcalf and Luckmann, 1994.

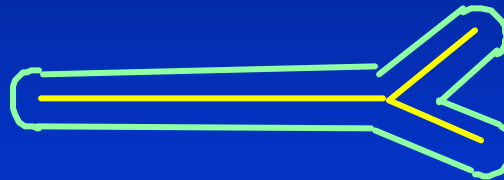
Special Techniques

Buffers

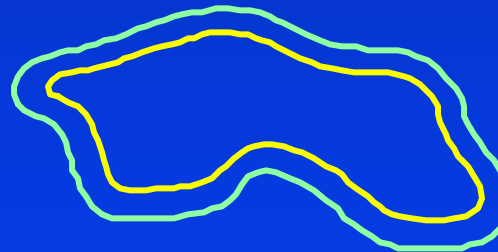
Point



Line

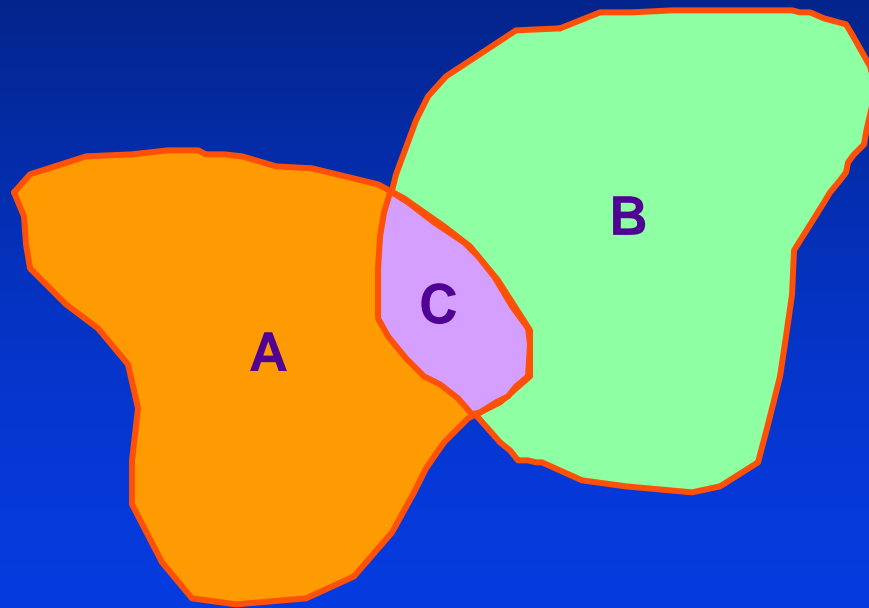


Polygon

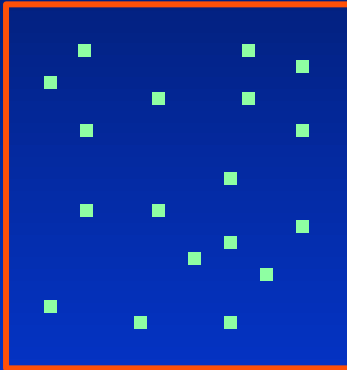


Special Techniques

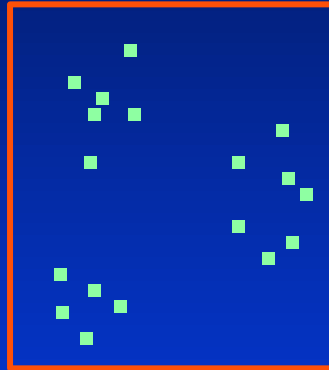
Intersection



Spatial Patterns

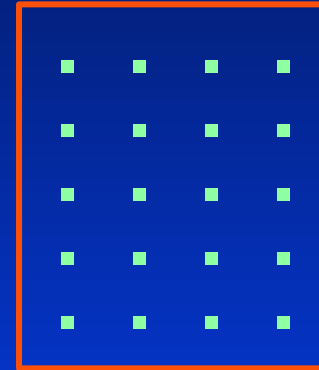


Random



Aggregated

(Contagious)
(Clumped)



Regular

(Uniform)

Remote Sensing

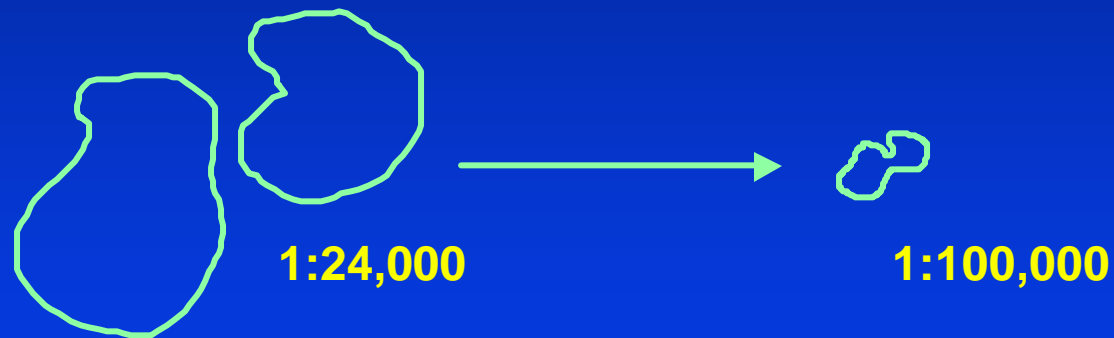
Definition

The gathering of information about the earth without having the sensing device in direct contact with it.

- Aerial photography
- Satellite imagery

Generalization

Definition - Process of adjusting the content of a map to provide a useful representation of the real world.



Comparison of Geographic and Spatial Analyses

Geographic

Lat



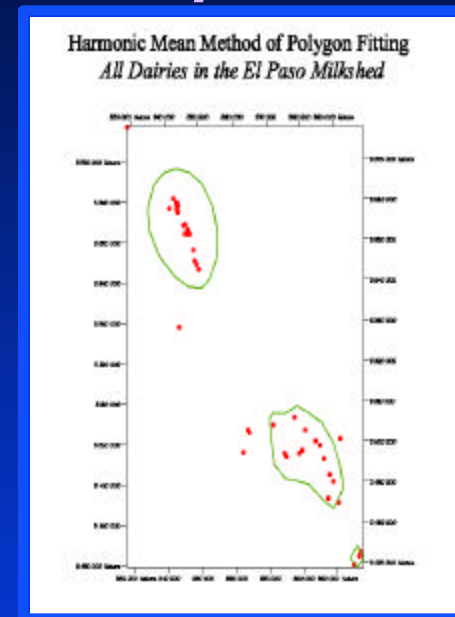
Lon

- Environmental Relationships
- Geopolitical Features
- Landscape Modeling



Spatial

Y



X

- Distance, Areal, and Geometric Relationships
- Modeling of Features in a Shape and Form Context

GIS *is Not* . . .

- . . . a program or a project --- it's a tool**
- . . . a statistical software program**
- . . . just “pretty” maps**
- . . . easily defined**

Summary

- GIS is a highly flexible tool for the display and manipulation of complex spatial data.
- GIS methods are well suited to surveillance and control operations.
- Successful GIS applications require careful planning.
- The scientific or operational question must be the driving force.